Synchrotron radiation-induced microXRF and XANES spectroscopy to study pollutant materials in soils and assess phytoremediation strategies

Pérez C.A.[a], *Mera M.F.*[b], *Rubio M.*[b,c,d], *Galván V.*[c,d], *Vicentin F.*[a] *and Germanier A.*[b]

[a]*Brazilian Synchrotron Light Laboratory (LNLS), Caixa Postal 6192 CEP 13083-970 Campinas/SP, Brazil,* [b]*CEPROCOR, Álvarez de Arenales 230 (5000),Córdoba, Argentina,* [c]*FAMAF,Ciudad Universitaria (5000),Córdoba, Argentina,* [d]*CONICET, Rivadavia 1917(1033), Buenos Aires, Argentina.*

Author Email: carlos.perez@lnls.br

A full understanding of toxic element behaviour in the environment ultimately depend on molecular-scale structure and properties [1]. In this sense, spatially resolved Synchrotron Radiation microXRF (SR-μXRF) and XAFS allow for the study of molecular-level processes occurring at critical boundaries in environmental sciences.

In this work, the mineralogical composition and spatial distribution of Pb and Sb species in corroded ammunitions are reported to understand how they react in the soil, influencing the bioavailability and contamination risk. Furthermore, the phytoextraction technology uses plants to extract toxics metals from contaminated soils and accumulate them in the harvestable parts of the plants, which can then be removed from site. In this sense, SR-μXRF analysis is essential to examine the spatial distribution of Pb and other elements in different parts of plants in order to know its capability for incorporating these elements.

SR-μXRF elemental maps of Pb and Sb were performed at the D09B XRF Fluorescence beamline of the LNLS on selected samples focused on process like (litharge→ hydrocerussite →cerussite) going to more stable phases that immobilizes Pb in soil [2]. XANES measurements at the Sb L-edges were carried out at the D04A SXS Soft X-ray Spectroscopy beamline of the LNLS in order to identify its oxidation states in crust. For plants, the experiments were conducted in *Lolium perenne sp.*, grown in soil contaminated with Pb, and in hydroponics crops exposed to lead at industrial and basal levels. SR-μXRF measurements were performed *in situ* on different parts of the plant (roots and leaves) and in living conditions.

A positive correlation between Sb and Fe was detected in crust material measured in the outer rim of the weathered bullets due to Sb adsorption to Fe oxyhydroxides of soil. It was also observed a spatial correlation between Sb and Cu and between Sb and Zn in crust. Results from XANES showed that the main species found in all samples was Sb5+ (Sb_2O_5) followed by metallic Sb. For plants, the results showed the hydroponics crops of *L. perenne sp*. can extract and translocate Pb from the ground to the leaves more effectively than plants grown in contaminated soil, where lead mainly stayed in the root. In addition, a spatial correlation between Pb, S and P distributions was observed.

Some conclusions about the current results as well as future activities will be sketched.

References

[1] Sparks DL, *Geoderma* 100, (2006) 303-319.

[2] M.F. Mera, M. Rubio, C.A. Pérez, V. Gálvan, A. Germanier, *Microchemical Journal* 119 (2015) 114–122